DOCUMENT RESUME

ED 074 099 TM 002 462

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TITLE The Development and Evaluation of a System for the Design of Instructional Plans and Resource Allocation.
PUB DATE Feb 73
NOTE 27p.; Paper presented at the annual meeting of the American Educational Research Association, February 1973

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Formative Evaluation; *Instructional Design; Instructional Systems; Models; *Resource Allocations; Technical Reports; Unit Costs; *Unit Plan

ABSTRACT

The development and evaluation of a system for designing instructional plans and resource patterns for those plans are described. Development of the system, which was in three stages, was based on the premise that decisions concerning efficient allocation of resources and the use of resources for effective instruction cannot realistically be made in isolation of one another. Brief descriptions of the conceptual and procedural stages of development are given, but the focus is on the first formative evaluation and revision of the system. The initial version of the unit design component subjected to formative evaluation and revision consisted of eight steps: (1) setting the frame of reference for planning and checking planning materials; (2) selecting and sequencing objectives; (3) assigning objectives to domains of learning; (4) selecting instructional procedures; (5) formulating an instructional strategy; (6) allocating resources; (7) delivering plans to administrative and clerical personnel for costing; and (8) removing constraints regarding implementation of the instructional strategy. Teachers performed these eight steps, and their efforts and resulting plans were analyzed to determine whether the procedures were effective and all objectives were met. Revisions were made in the procedures based on the analysis. (KM)

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# The Development and Evaluation of a System for the Design of Instructional Plans and Resource Allocation

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Prepared for presentation at the Annual Meeting of the American Educational Research Association. February, 1973.

## Purpose

This paper presents a description of the development and evaluation of a system for designing instructional plans and resource patterns for those plans. Brief descriptions of the conceptual and procedural stages of development are given, but the focus of the paper is the first formative evaluation and revision of the system. Detailed descriptions of the conceptual and procedural stages are available from the Evaluation Training Center (see p. 3 for address) as well as for other formative evaluations conducted. The final section presents a description of the model in its present form.

## Introduction

The system, which is the subject of this paper, was developed by the Evaluation Training Center (ETC) of the Department of Educational Research, Florida State University, under a contract with the State of Florida Department of Education. The unit design component is a sub-system of a larger entity called the Resource Allocation for Instructional Improvement (RAII) system. This larger entity consists of components for 1) course design, 2) course revision, 3) unit analysis, and 4) unit revision, in addition to the unit design component.

The ultimate goal of the RAII system is the improvement of the educational process through the effective and efficient use of educational resources. Development of the system was based upon the premise that decisions concerning efficient allocation of resources, and the use of resources for effective instruction cannot realistically be made in isolation of one another. In addition to this premise, the State Department of

The author would like to acknowledge the contributions of Dr. Margaret Bell, Dr. George M. Huntley, Ms. Mary Ann Domanski, and Ms. Judith Huntley to the content of this paper.

Education furnished several requirements for the system which were to serve as design criteria for the development of the unit design component. These criteria were: 1) use of the system under in-field conditions by public school personnel should not be contingent upon continuing consultation by ETC or any other agency outside the public schools, 2) users should not require extensive special training prior to being able to apply the system, 3) it should be equally applicable to traditional and innovative programs, and 4) use of the procedures should not be limited because of the teaching level (K-12) of the user, nor because of the discipline (math, art, physical education, industrial arts, etc.) the user was attached to.

## Stages of Development

Development of the system occured in three stages. The conceptual stage resulted in the production of a conceptual model for unit design (January-April, 1971). The period April to December 1971, focused project staff efforts upon the development of a basic procedural model. A series of three cycles of formative evaluation and revision comprised the third major stage (January-December, 1972) and focused upon the development of a final product which would meet design criteria specified at the outset of the project.

Brief descriptions of activities in the first two stages are provided, as detailed information is available in the April and December (1971) interim project reports. Emphasis will be given to the description of activities and results of the third stage, as it was the most crucial to the development of the project and use of its results, sets the unit design component apart from other training materials which have been prepared to provide skills for teachers in the area of instructional planning.

### Conceptual Stage

In the tradition of most academic efforts, this stage began with an

intensive review of research literature in such areas as educational costs, systems analysis, management systems, instructional research, and the psychology of learning. The breadth of the review was necessary because of the absence of a synergetic prototype upon which development efforts could be based. At the same time, communication was established with those persons on the national level who might have been involved in the development of a similar system. While these efforts were not productive in the sense that they provided specific structured input for developmental efforts, most of the major concepts which characterize the final product were obtained through this effort.

The conceptual model which emerged from this stage resulted from a synthesis of effort by several members of the project staff that might be best described as adversary proceedings. Differing ideas were submitted to intensive examination by project staff resulting in the selection of Gagne's (1971) concept of domains of learning to serve as the theoretical foundation of the unit design component. In addition, project staff settled upon Briggs' (1970) style of proceduralization as a model for continued development of the operating procedures of the component.

These two selection decisions were based upon the direct applicability of the two works cited to the task of designing instruction. Adopting these works set the stage for developing a procedural model which would be based upon requirements added to the beginning premise of the project. These additional requirements, which were constructed from staff interaction, and were supported by both Driggs and Gagne, included: 1) successful learning in different domains requires different conditions and processes of instruction, 2) instructional procedures should be chosen to fulfill specified objectives for the learner, and 3) decisions about managing students and resources should be made to support the use of appropriate procedures which are research based;

traditional or preferred teacher practices should not dictate the selection of instructional procedures unless there is no more objectively supported basis.

Procedural Stage

In this portion of the developmental process, the project staff was concerned with the production of a set of global procedures which would enable teachers to begin the planning process with a set of behavioral objectives and end it with alternative instructional strategies appropriate for those objectives and resource patterns necessary for implementing those strategies. These global procedures were to be the rough draft of the unit design component which would be operationalized in the third developmental stage to meet the demands of in-field instructional situations, and the demands imposed by previously designed criteria.

While there was limited classroom teacher participation in this stage, the greatest productivity was gained from project staff production, participation in, and critiques of, individual and group efforts. Simulated instructional inputs were described as the global procedures were developed to lend reality to project staff efforts. The limited teacher participation did promote one decision which influenced further development efforts. Many of the concerns dealt with in the global procedures were without common definition, and wide variance in planning behaviors were evident even in the small number of teachers participating at this stage. To provide for the standardization of terms and concepts employed in the procedures so that users would not be hampered by differential interpretation of those terms, and to provide for a common base of planning capabilities among teachers using the unit design component, a set of supplementary references was outlined, and initial development on them was begun.

At the end of this stage the design model consisted of eight steps and a compendium of learning activities. While these global steps were to be

equivalent to the content of steps in the final product, the finite sub-procedures within the steps were minimally developed, and the relationships among steps were only tentative. Operationalizing these relationships, revision to provide for real demands which would be placed upon the system in field situations, and development of supplementary references were to be accomplished in the third stage.

Formative Evaluation and Revision Cycles

Cycle One. The initial version of the unit design component which was subjected to formative evaluation and revision consisted of eight steps. Step one required setting the frame of reference for planning and checking planning materials. Selecting and sequencing objectives constituted the second step. The third step directed the user to assign objectives to domains of learning. Instructional procedures selection was the fourth step. Step five consisted of formulating an instructional strategy. Resource allocation was accomplished in the sixth step. In the seventh step, the user was directed to deliver his plans to administrative and clerical personnel for costing. The final step consisted of removing constraints existing with regard to implementation of the instructional strategy.

In performing these eight steps, teachers made use of four worksheets, a catalog of instructional procedures, and sets of minimal resource patterns constructed for each procedure. The eleven teachers participating in this cycle represented two schools, elementary and secondary levels, and various subject matter concentrations. Their efforts in applying the model were subject to extensive assistance from project staff members. Data gained from this effort was to be used to provide for increasing teacher participation and minimal project staff participation in formative evaluations to follow.

The major goal of the formative evaluation plan was: To determine the extent to which revision of the unit design component would be necessary to

insure its operating capability independent of extensive ETC intervention, and to gather data to aid ETC in revising the procedures toward this goal. In addition to the assumptions guiding project efforts, and the design criteria provided by the State Department of Education, this major goal subsumed two other goals for the evaluation plan. The reader may wish to refer to the schematic representation of this plan presented in the last pages of the paper for aid in understanding relationships among goals, objectives, activities, and data interpretation in the evaluation plan.

First, it was assumed that teachers' independently produced output, using the unit design component would meet the component's intrinsic criteria. Second, it was assumed that these products would result from applying a set of procedures that was user-effective--a model whose intent was difficult to violate accidentally--and a set of procedures that was user-efficient--the time and effort required to implement them would be amply compensated for by the quality of the product of user efforts. These two criteria, user-effectiveness and user-efficiency, served as bases for construction of two sub-goals under the major goal. These two goals provided the basis of development for specific evaluation objectives, activities, modes of analysis and interpretation, and revision criteria.

The first sub-goal was to determine whether plans produced by users of the unit design component met the intrinsic criteria of the procedures; i.e. whether the procedures were in one sense, user-effective. This goal implied three objectives which will now be specified, along with formative evaluation activities connected with each objective and data analysis and interpretation procedures which were used to convert the data gained from those activities to specifications and revision of the procedures.

Objective one for sub-goal one specified the intrinsic criteria of the procedures so that user products could be evaluated against them. The

objective was: For each user product, determine whether, 1) objectives are correctly sequenced from least to most complex, 2) objectives are correctly assigned to domains of learning, 3) alternate instructional procedures listed for each objective are appropriate for the domain of the objective, 4) instructional procedures selected are consistent with user-specified management strategy, 5) at least one instructional strategy appropriate to learners, objectives, and management strategy is specified, and 6) a resource pattern consistent with the selected strategy is specified.

The plans, which were subjected to analysis under this objective, were the results of teacher efforts after basic orientation and training activities were completed. Using a very specific checklist (consisting of characteristics plans should have to meet the demands of each aspect of objective one) which was constructed by a member of the project staff, two staff members independently examined the plans produced by teachers. The essence of this analysis activity was that those examining plans applied the procedures to the learners, situation, and objectives specified by users. Staff members compared results of their analyses for each set of plans and negotiated to remove discrepancies between their judgments, which were few in number due to the specificity of the checklist and the consistency of staff members' applications of the unit design component.

Results of these activities showed that numbers of errors decreased with successive applications of the procedures, but that the number of errors in teachers' final applications of the procedures were too numerous to say that the plans met the intrinsic criteria of the procedures. This evaluation was made even though most errors in the final application reflected a lack of clarity and specificity in the procedures which could be corrected through minor revision.

This determination regarding the need for revision could be made by comparing the results of the planning activity with the results of another activity associated with the objective. Using a worksheet, project staff categorized the scope and nature of each question raised and each difficulty reported by teachers in the course of applying the unit design component. Analysis of these results enabled; 1) location of trouble spots within the model, 2) determination of the relative strength of difficulties encountered, and 3) the seriousness of effects of errors which were likely to occur at each point. Questions raised and difficulties encountered by teachers demonstrated a strong relationship with errors which characterized teachers' final applications of the procedures. This relationship not only identified the areas at which revision efforts should be directed within the procedures, but also provided guidelines for the extensiveness of revision required, the content of those revisions, and the form those revisions should take.

In the evaluation plan, the purpose of objective two of sub-goal one was to determine whether teachers using unit design procedures produced plans which were different from their normal plans with respect to aspects of the unit design procedures which were thought to be unique. Specifically, the objective stated: For pairs of user products for ETC specified objectives, with one product resulting from teachers' normal planning procedures and the other from application of the unit design component, determine the degree and types of similarities and differences regarding; 1) specification of learner characteristics, entering competencies, and unit goals, 2) user's examination of the content and usability of the objectives, 3) sequencing objectives from most to least complex, 4) choosing appropriate learning procedures for specified objectives, 5) considering important functions of instruction,

6) specifying amounts of time for discrete instructional procedures and for the strategy as a whole, 7) choosing a management strategy appropriate for learners, objectives, and instruction, and 8) specifying resources necessary to implement the selected instructional strategy.

Two project staff members were responsible for making these comparisons. The results of these comparisons related to the matter of user-effectiveness in that if the unit design component did not have the capability of producing changed behavior in planning strategies for teachers (if results of its application duplicated normal planning results), its effectiveness would be considered to be highly marginal. Results of this activity allowed examination of the component's effectiveness from this frame of reference, as well as revealing the aspects of lesson plans where the most noticable differences occured. Effectiveness of the component was confirmed in this activity in that more teachers' plans using the component provided for each of the aspects specified in objective two, particularly in relation to sequencing, specifying time for instruction, attention to functions of instruction, and specification of resource patterns. In order to assure that these results were not a function of the sample of teachers participating in the first cycle of the formative evaluation, this activity was retained in future evaluations with analyses yielding very similar results.

The third objective under sub-goal one of the evaluation plan was concerned with seven critical decision-points existing in the procedures where the user was provided with only minimal information for decision-making. This objective related to the determination of the adequacy of information provided at each of these points, factors influencing user decisions when information provided was judged to be inadequate, and criteria used to evaluate the correctness of the decision made.

The manual used in this cycle of the evaluation had inserted in it, immediately following each of these critical decision-points, directions for the user to record his perception of the adequacy of information provided, additional factors influencing the decision made at that point, and criteria used to determine the appropriateness of the decision made at each point. By examining the information recorded by users across all decision-points, and noting those factors and criteria most often cited as influencing each decision, project staff were able to determine what additional types of information and form for that information, needed to be included at each decision point to insure that information provided was appropriate to the demands of respective decisions.

The second sub-goal of the evaluation plan related to determining the user-efficiency of the unit design component and additional aspects related to its effectiveness not accounted for under sub-goal one. Determination of user-efficiency focused upon; 1) time needed to apply the component, 2) user difficulty with model terminology and clarity, and 3) user difficulty resulting from lack of training. User-effectiveness aspects focused upon under this goal were concerned with; 1) determining the degree of satisfaction expressed with user products resulting form applying the procedures, 2) the capability of the procedures for enabling users to apply skills in which they were not proficient without the procedures, 3) to determine teacher perception of applicability of the component in real situations with which they were familiar, and 4) specifying limitations which situations would impose upon use of the model which could not be removed by revising the procedures.

Under sub-goal two, the first objective was concerned with time factors associated with the application of the procedures: For each user product, document time taken to complete each step in the procedures to determine;

1) whether time required decreased with successive applications, 2) whether units with more instructional time estimated for them required longer application time, 3) whether the same users consistently required greatest amounts of planning time, 4) whether units having greater numbers of objectives required greater application time, 5) which steps were the most time consuming, and 6) if procedures were equally time-efficient for both elementary and secondary teachers.

In each application of the component, teachers were asked to record starting and ending times for each step in the procedures. Project personnel examined these recorded times and determined that individual and average application times decreased with successive applications, and that instructional time planned for was the best predictor of maximum time needed to complete the procedures. Furthermore, there were only slight relationships between time used and individual users, and time to apply and number of objectives in the planned unit. No difference existed in planning time required for elementary and secondary users.

While these data tended to support the contention that the unit design component was time-efficient relative to the aspects specified in objective one, the total times for users of the model were too great, even with the trend of decreases in succesive applications, to support the time-efficiency contention. Data gathered in a previously mentioned activity (the recording of all questions and difficulties encountered in applying the procedures) was useful in revising the procedures to increase total-time efficiency. The steps which required the most time were also the steps which most user questions raised were concerned with, and which caused users greatest difficulty. By removing the sources of these difficulties and questions from

the procedures, it was thought that the revised procedures would be efficient in terms of total time required.

In evaluation objective two under sub-goal two, project staff were interested in specifically identifying those locations in the procedures and supplementary references which furnished sources of difficulty in applications. The objective was: For each user and each application, document the nature of questions, requests for aid, and their respective locations to determine whether shortcomings result from; 1) perceived shortcomings in the substance of the procedures, 2) user concern for the effects of the procedures upon his product, 3) lack of clarity in language used, and/or 4) lack of training in using the model.

These documentations were made by project staff using a form which structured feedback given by users to meet the demands of the evaluation objective. While analysis of these data showed that total number of instances of user difficulty decreased with successive applications, and instances of difficulty decreased for each location, these decreasing frequencies did not furnish support for the contention that procedures were user-effective (users expressed satisfaction with their efforts and with the time-effort/output ratio) in that form. It was thought that revision in high incidence difficulty areas would remove procedural and language difficulty and ameliora te users' continuous concern as to whether they were proceeding correctly in their applications of the unit design component. This was especially true for the first application where anxiety seemed to be very high and attitudes toward the procedures tended to be negative.

The third objective under this sub-goal was to determine user attitudes, after successful experience in applying the unit design component, toward

the component as an entity and toward specific aspects of the component. A questionnaire was designed to gather data for this objective, administered after three days of working with the component, anonymously completed, and returned to ETC personnel. Responses were compiled, and the resulting data used for input for revision.

This activity related to concerns of both user-effectiveness and user-efficiency of the component. In order to promote use of the procedures under normal conditions, the unit design component not only had to be effective according to its intrinsic criteria, but by criteria of effectiveness applied to it by users. If learning to use the component did not promote positive attitudes toward it, the liklihood that teachers would voluntarily apply it would be likely to decrease. Even in voluntary applications, if negative attitudes toward the component prevailed, users might fail to take care in application of the procedures, thus reducing the liklihood that their products would meet the component's intrisic criteria.

Data from this activity furnished input for revision, in that generally positive attitudes toward the component were revealed, and highly favorable perceptions of some of its procedures resulted. Most important to revision, however, was that aspects of the component were perceived to exert a negative effect were revealed. These data were analyzed in relation to ar as of difficulty revealed under objective two, and errors in applications revealed in data obtained under objectives in sub-goal one. This examination enabled additional direction of revision efforts toward those areas in the procedures which were deemed to raise negative feelings in users, as well as toward those areas which indicated a need for revision based upon user performance data.

The fourth objective under sub-goal two was concerned with determining whether users were proficient at applying skills contained in the component

without having access to the procedures themselves. This objective was accomplished by administering a series of tests to users after basic orientation to the content of the component, but before they engaged in any application activities. Arbitrary levels for mastery of the tests were set by project personnel. The skills which the tests were designed to assess included; 1) differentiating between behavioral and non-behavioral objectives, 2) assigning objectives to domains of learning, 3) making time estimates for given instructional instances, 4) recognizing instructional procedures appropriate for objectives from different domains of learning, and 5) sequencing objectives for instruction. Each of these tests was related to a specific step in the procedures where each of their applications was required. By comparing results of the tests with results of errors in application of the component, a determination could be made relative to the component's capability for enabling user application of skills using the component, which they had not mastered outside the procedures.

While only one teacher achieved the arbitrary mastery level for one test, examination of second applications of the procedures showed that each user achieved mastery levels, with regard to skills assessed by the tests, in his plans. This evidence tended to support the contention that the procedures gave the user the capability to use skills which he had not mastered, thus lending evidence to the user-effectiveness of the unit design component.

In unstructured group feedback sessions, and in all contacts with teachers involved in the formative evaluation, ETC staff recorded user comments which they felt would be useful input for revision efforts. Those comments which were restatements of comments gathered under objective two, sub-goal two were along with that data. Those comments which were not replications were discussed among the three ETC staff members most extensively involved in the formative evaluation. These staff members worked to achieve consensus on the points of

feedback which would be most vital to revision efforts and structuring future applications of the unit design component.

Discussion of Results

Data obtained from these activities support the contention that user products meet the intrinsic criteria of the procedures, especially after one application. The number of minor errors, due to user carelessness and misunderstanding of the procedures, however, called for substantial attention to be given to revision of clerical and procedural nature.

Comparisons of teachers' normal plans, with plans produced for the same units using the design component, revealed that those in which the component were applied and greater clarity, specificity, and were quite different from normal plans. This was especially true regarding correct sequencing, specification of resources, learner characteristics, and management characteristics. Since each of the eleven teachers in the formative evaluation had been identified as an outstanding representative of his faculty, implications of this result for novice teachers, or teachers not identified as being outstanding, could not be sorted out meaningfully. Based upon this result, a decision was made to seek a cross-section of teachers (based on Department of Education school selection) in the second cycle of the evaluation, to determine whether support for the effectiveness of the component could be compiled for those teachers.

In objective three of sub-goal one (input to decision-points with only minimal information provided), most teachers citied previous teaching experiences and knowledge of students as input for each of the seven decisions. If prior experience enabled then to make decisions which resulted in products being consistent with intrinsic criteria, then revision had to translate teacher experience into procedural form so that inexperienced teachers would be able to take, if you will, "algorithmic advantage" of the experiences of others.

Use of the component's supplementary references (catalog of instructional procedures, decision matrices, resource patterns, domain descriptions, etc.) influenced effectiveness and efficiency of applying the procedures. In initial applications of the component, many teachers cited their lack of facility in using these references as being detrimental to the accurate application of procedures. ETC staff were constantly asked to demonstrate relationships between procedures and supplementary references users were directed to by the procedures. In revision, this uncertainty had to be overcome to increase the effectiveness of the component.

Under sub-goal two, results suggested that an extension of the orientation period would be appropriate to the task of increasing time-efficiency of the procedures. However, the strong relationship between planning time required and the length of instruction planned for, indicated that efforts should be made to reduce trained user time in revision; i.e. to decrease time required for training users. This implied that revision efforts should be directed toward increasing the algorithmic nature of time consuming steps, thus decreasing time required for the first application ( which exterted a training effect) and error probabilities and increasing the efficiency and effectiveness of the component.

Many user criticisms of the procedures, requests for aid, and questions raised were concerned with specific terms and their definitions. The decrease in errors and difficulties reported following initial application would seem to minimize the need for extensive clerical revision. However, due to the importance that users assign to the initial application, it seemed to be crucial to minimize vocabulary difficulty, thus reducing the anxiety teachers associated with the initial application.

While results of activities under this sub-goal suggested that the component could be made user-effective and user-efficient through clerical and

procedural revisions, several frequently cited comments by teachers suggested that the implementation environment would exert more effect upon its success than the component itself. These concerns were related to the possibility of misuse of the component by administrators to force teachers to use least costly alternatives produced in planning, insuring that delivery and support systems in the district of implementation operate at a more effective level than they presently did in schools represented by the teachers, and teachers must be given greater authority over the allocation of resources if the model is to be used effectively. This last point was raised because centralized allocation of resources effectively removes the teacher from being able to accomplish flexible resource use.

Several unanticipated outcomes of the evaluation held implications for future applications of the component. Teachers agreed that the component could be beneficially used as; 1) an in-service course for teachers who are beginning to deal with performance-based instruction, 2) content for pre-service teacher education courses, 3) a longe range planning tool for districts with stable teacher populations, and 4) an effective and efficient tool for team-based planning.

This final outcome resulted from a decision to ask three teams of teachers to apply the component to a unit they were all interested in. This was simply to test the feasibility of team use of the model--an application which did not fill project staff with optimism due to the idiosyncratic planning behaviors observed in individual applications of the component. However, two teams produced plans which were free of errors, quite explicit, characterized by specification of multiple alternate instructional strategies, and which took less application time than any single-person application. Attention in the revision plan was given to providing for team applications as a training activity.

Plan for Revision

Revision efforts deemed to be necessary upon examination of results of the first cycle formative evaluation in comparison with design criteria, caused the project staff to focus revision effort upon four areas. These areas of concern were 1) training and orientation, 2) revising steps in the procedures, 3) revising supplementary materials, and 4) developing additional references to aid in the application of the component in less than optimal conditions.

In training and orientation, the development of a prototype product was undertaken to provide a programmed application of the procedures in the initial application experience. This product demanded that users perform parts of each step in the component, and allowed them to check their performances against "answer sheets" provided by ETC application of the procedures. Time alloted to this activity was increased in the schedule of evaluation events to allow for sufficient time in the initial application, which users deemed to be so important in the first cycle. Teachers' serious difficulties in sequencing objectives was given attention through the development of illustrative examples of alternate sequencing of the same objectives, with accompanying explanations of probable results from implementing each sequence. A team application exercise was included so that teachers could discuss and clarify impressions regarding steps in the procedures, and take advantage of learning from one another on a structured basis, as unstructured exchanges in the first cycle had proven to be so productive for participants. The evaluation schedule was revised so that an orientation and training period which was distinct from the design was created. Exercises were developed which allowed participants in the second cycle to practice discrete skills in relating the supplementary references

to their proper steps in the procedures.

Revisions made in the steps of the procedures included reordering them so that classification of objectives into domains occured at an earlier point. This enabled users to have more information available when dealing with the problem of sequencing objectives, and also required the user to examine his objectives from the frame of reference of explicitness of instructional intent, following delineation of entering competencies of learners and expectations of the learner for the unit. An additional worksheet was developed for this purpose. The worksheets were redesigned so that objectives were only written once on slips of paper which could be moved from worksheet to worksheet as required in application of the model. Each troublesome term cited in the first cycle was defined the first time it was used in the procedures and reference to the location of that definition was made in each subsequent appearance of the term. The amount of writing required in steps three and four was reduced by inserting numbers in the instructional procedures matrices, for each procedure, so that users were only required to record it rather than the name of the procedure. Instructions for selecting management and pacing strategies were altered to promote needs of learners, and learning requirements of the domain of the objective, as the basic criteria for making these selections. Criteria cited by teachers at the seven major decision points in the first cycle, were added to the information included in the procedures at each of those points to give novice and inexperienced teachers sufficient criteria for decision-making at those points. The worksheet for specifying resources was altered significantly by greatly increasing the extent of specificity of data required to insure that costing information could be obtained there. Constraint removal and costing were excluded steps of the component. Reference to costing caused

teacher tempers to flair as they felt that including that step in the procedures would allow administrators to assign that task to them instead of providing for clerical performance of the task. The teachers argued very effectively that constraint removal would have to take place at the school, or at least the department level, for those were the lowest levels at which decisions about constraints upon changing instruction (scheduling, resource allocation, load assignment, etc.) could be effectively made, as those were the lowest levels at which flexibility of resource use could be effected.

Regarding supplementary references, descriptions of alternate resource patterns for implementing instructional procedures using differing management strategies were produced to demonstrate flexible resource use. These patterns considered constraints imposed by limited resource pools which are normally immediately available to teachers. A major revision of descriptions of instructional procedures was undertaken due to user criticism of the language used. Users felt that rewriting should convert the descriptions to "teacher language" from the "academic" language used. A set of directions and self-tests for users to employ in orientation was developed to allow users to determine whether they had acquired verbal information necessary for independent application of the procedures. The matrices for selection of instructional procedures were revised so that information provided in the descriptions of the procedures was algorithmically included in the selection of a procedure.

Subsequent Formative Evaluation and Revision

Following the second formative evaluation, a second major revision of the unit design component was undertaken. The basis for revision was data gained from applying the revised version of the component from cycle one, within the evaluation plan described in the preceding sections. In formative

evaluations following the second cycle, some discrete revision was accomplished in the procedures, but most attention was given to providing training materials which would serve the same functions performed by ETC personnel in the first two formative evaluations.

In the second major revision of the unit design component, analysis of data from the evaluation plan pointed to the need for several revisions. First, the preparation of orientation and training activities which were distinct from application activities proved to be ineffective as they seemed to result in increased anxiety levels during orientation and the first application. This increase seemed to result in increased difficulties being encountered, questions raised by users, and errors in application of the procedures. The programed application of the component failed to achieve the objective of "small step" familiarization with the component, as teachers perceived the exercise to be a test of their abilities, rather than a learning experience. The team application was the one highly successful training procedure which had been incorporated in the second formative evaluation. Based upon feedback from these teachers, the decision was made, for the next version of the unit design component, to continue the concept of programmed application, but the steps of the application were inserted within their related steps in the procedures as practice exercises, thereby combining training and application activities as had been the case in the first formative evaluation. This strategy, followed by team application of the component, proved to be quite successful in subsequent formative evaluations.

Revisions of the steps and clerical changes removed many of the difficulties cited in the first formative evaluation. In the second evaluation, teachers found the number of worksheets to be excessive, and the amount of writing required to be conterproductive to effective use of the component. Using data

gained from the teachers, the number of worksheets was reduced to three, and through revision of steps concerned with selecting instructional procedures, the amount of writing required was reduced by approximately one-half. In subsequent use, this revision resulted in a one-fourth decrease in required application time, after initial application. The activity related to determining criteria used at the seven critical decision-points did not produce any information that was different from that obtained in the first formative evaluation. This result was duplicated in subsequent usage of the procedures, which lent support to the contention that revisions included at these points following the initial evaluation to furnish decision criteria sufficient for decision-making by novice teachers. Remarks made by participants in the initial formative evaluation concerning constraints upon effective implementation of the component, arising from the implementation environment, continued to chrac-terize open feedback sessions. The themes of these remarks were always fear of misuse of the component by administrators, low operating efficiency and effect-iveness levels of school systems' clerical and instructional support arms, and lack of teacher authority in resource allocation decision-making.

Due to teacher difficulty in generating instructional strategies which allowed flexible resource use, another supplementary reference was developed following the second formative evaluation. It is called the "Teacher Alterna-tive Time Use Guide." It demonstrat how differential demands upon teacher time can be designed for differing management strategies. The guides allow the user to see how combinations of differing instructional procedures can be devise which will maximize teacher capability to deal with individual students, or to perform other high priority tasks which often go wanting in instructional situations where relatively high teacher involvement is required in all aspects of instruction.

The Catalog of Instructional Procedures was subjected to clerical revision once again, and placed in a binder of its own, as its length added great bulk to the component and hindered its effective use because of access difficulties. Selection of instructional procedures was reduced in difficulty to a series of highly structured decisions. After assigning objectives to domains and selecting management strategy, the user is now directed to a set of matrices where groups of instructional procedures appropriate for the specified conditions are listed for each instructional requirement (condition of learning) of the domain of the objective. While this revision decreased the number of instances of teachers' creative use of the procedures slightly, it greatly increased the capability of the procedures promoting achievement of intrinsic criteria in user products.

The Current Developmental State of the Unit Design Component

At the end of the project funding period, the procedures consisted of five steps. In step one, the user identifies unit goals, learner characteristics, and entering competencies. This enables; 1) setting a frame of reference for planning, 2) beginning in instructional planning where the learners are in relation to achieving unit objectives, and 3) use of a maximum amount of available knowledge about learners.

The second step enables the user to select or write objectives and assign objectives to domains of learning. This promotes; 1) use of catalogs of instructional objectives being developed under contract with the State Department of Education, 2) evaluation of objectives used for form and content, 3) revising objectives so that they meet intrinsic criteria of the component, and performing the most critical operation of the procedures relative to effective application; 4) correctly assigning objectives to domains of learning. Step three directs

the user in sequencing objectives for instruction in accordance with requirements of the several domains of learning.

The fourth step allows the user to develop instructional strategies appropriate for the objectives. This involves: 1) specification of management (direction of learner activity) and pacing (determination of learners' rate of progress in the unit) types, 2) selecting instructional procedures for each objective; that choice being regulated by the domain of the objective, instructional requirements for that domain, and management and pacing type selected, and 3) screening strategies for their provision of motivation, variety, ease of switching from activity to activity, student evaluation, and providing for special cases among students.

Step five is concerned with constructing resource patterns for alternative strategies designed, and selecting one of them for implementation. Specifying resource patterns requires estimating time required for each instructional procedure, selecting resources for instructional procedures by instructional requirement, and providing for careful consideration of using teacher time. In addition, this step provides a decision-making model for strategy selection which requires that the user evaluate relationships among projected student achievement, planning time required, and availability of specified resources.

This version of the component has been used by teachers K-college for producing instructional plans, by a state department of education to construct a curriculum guide with usable format for teachers, and as a base for Independent Program Assessment (evaluation of cost/achievement in different districts for same objectives) by the Florida State Department of Education. Implications for its future use include; using the component in district-wide comprehensive educational planning, developing parts of a system for accountability, and in aiding implementation of performance-based accreditation programs.

## Resources


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## Evaluation Plan

Sub-goal I: To determine whether products produced by users of the unit design component (UDC) meet its intrinsic criteria.

Objective 1: For each user product, determine adequacy in terms of six UDC criteria.

Activity: Monitor and analyze results of individual applications.

Objective 2: Determine whether UDC products differ from products of users' normal planning regarding eight UDC criteria.

Activity: Compare UDC plans with normal plans.

Objective 3: Determine factors influencing user decisions at seven points in the UDC.

Activity: Recording and analyzing criteria used by teachers.

Sub-goal II: To determine whether UDC procedures promote its being a user-effective, user-efficient, operation for planning in specified instructional situations.

Objective 1: Determine relationships among time to apply UDC and factors of the planning situation.

Activity: Record time used, document selected planning situation factors, and analyze results.

Objective 2: Document requests for aid, difficulties, questions, etc.

Activity: Record feedback on structured form; analyze and compare to data resulting from other activities.

Objective 3: Assess user attitudes toward UDC.

Activity: Administer and analyze attitude survey.

Objective 4: Assess ability of user to apply skills using the UDC which he has not mastered in his normal planning behavior.

Activity: Problems in model use skill administered; results compared to UDC produced products.

Objective 5: Record all user feedback deemed relevant to revision efforts.

Activity: Record data in all open feedback sessions, record incidental feedback, analyze recorded feedback.